

Recommended Late Seral Forest Development Prescription for Brandon Gulch

**Report of the Jackson Demonstration
State Forest Advisory Group**

to

**Director
California Department of Forestry and
Fire Protection**

August 8, 2008

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Executive Summary

This Report from the Jackson Advisory Group to the Board of Forestry and the Director of CAL FIRE recommends a timber harvest prescription to be applied to the Brandon Gulch timber sale at Jackson Demonstration State Forest (JDSF). This prescription results from a directive from the Director to develop an approach to timber management that accelerates the development of late-seral forest conditions, while maintaining and developing important recreation values.

Little specific knowledge is available regarding how to accelerate "late-seral forest conditions" and how to determine when they have been attained. Late seral conditions include those found in old growth forests, but also are found as forest succession moves the stands into old-growth, or climax conditions. Elements within a late-seral forest include large trees, slowed tree growth, and occurrence of features such as snags, down logs, and mortality of overstory trees.

Because of the limitations of knowledge, the Committee took what it considers a cautious approach. The recommended prescription consists of two entries. The first will remove approximately 30 percent of current basal area and will be aimed at providing the largest trees with increased growing space to accelerate diameter growth rate. Most harvested trees will be redwoods from the co-dominant and intermediate crown classes. Most of the smallest, suppressed trees will be left to retain that cohort of trees while providing shade and site occupancy to limit the development of a new age class of regeneration. The prescription will be carried out to enhance multiple canopy layers and diversity in tree composition and density across the landscape. A second entry that will be considered in approximately 20 years will be designed after evaluating the response of the stand to the first entry and in the light of new knowledge and experience.

Recreation values will be maintained and, where possible, enhanced by attention to layout and conduct of harvesting operations, special sensitivity towards visual quality in setback areas adjacent to trails, campgrounds and streams, treatment of logging slash, and restoration of trails and trailheads after harvesting.

Demonstrating to the public the experience gained in carrying out the prescription will require gathering before and after information to describe the response of Brandon Gulch to treatment, assessing the extent to which development towards late-seral conditions have been accelerated, and evaluating the compatibility of forest management with recreation.

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1. Introduction

The Objective

A settlement agreement resolving various legal contentions among several parties, including Cal Fire, directed that an outstanding Timber Harvest Plan (THP) for Brandon Gulch “be amended such that the treatment objective shall be ‘acceleration of the development of late seral forest conditions’ (ALSF).” Further, the settlement specified that “The plan shall be treated as a demonstration in ALSF,” and also that consideration will be given to potential “harvest modifications to reduce visual impact on recreation users” (Appendix 2).

The Jackson Advisory Group was requested by the Director of Cal Fire to provide recommendations on a timber prescription for Brandon Gulch that meets the goals of the settlement.

Late-Seral Condition

A challenge in approaching this task is that there is no one definition of "late-seral condition". The JDSF Management Plan (p. 163) defines late seral forest as “having biological characteristics and functions similar to old growth forests.” It is part of the forest successional continuum that culminates in “old growth” or “climax forest”, but is better described in terms of the elements of stand composition and crown structures of dominant trees found in mature redwood forests. “Late seral” is best considered a condition of a stand, and not an individual tree.

Little knowledge and experience exist about actively managing 100-year-old stands to accelerate development of late seral conditions. Brandon Gulch is hundreds of years away from being an “old growth” stand, regardless of the treatments made now or in the future.

The nearly unique opportunity to actively manage a 100-year old stand for late seral is an exciting opportunity. At the same time, the limitations of knowledge make designing a management plan a formidable challenge.

Approach

The committee chose to be cautious in its approach. It also chose to focus on an obvious characteristic of late seral forests – developing large trees – while encouraging the continued development of complexity and diversity in the forest structure.

Based on the above considerations, a survey of existing literature and site visits, the committee recommends a prescription that will create openings around larger trees to accelerate their growth; keep canopy openings moderate to repress growth of a new age-class of trees and to maintain conditions for understory and ground-level biological processes; provide for recruitment of snags and large woody debris; move the distribution of tree sizes closer to those existing in old growth stands; and maintain and enhance recreation values in the area.

2. Late-Seral Forest Conditions

The term "late-seral" is a broad category of stand conditions typified by large trees, slowed tree growth (senescence), and occurrence of features such as snags, down logs, and mortality of

overstory trees (decadence). Examples of some late-seral forest elements present on JDSF are shown in Figure 1. Canopy gaps are filled in with shade-adapted understory trees and ground cover. With sufficient time, and without disturbance such as wildfire, shade-tolerant species will become a dominant stand component.

In redwood forests, stand-replacing events such as fire are rare. More commonly, fires in redwood forests are under-burns. Burned redwood trees commonly stay alive and replace their crowns with epicormic branches (small side branches formed following increased exposure to light or fire). Since redwood is shade-tolerant it often remains the characteristic, dominant species. With increasing age, redwood is more likely to topple than form standing snags. Redwood has renowned decay-resistance thus the presence of down logs is a better characteristic of late-seral conditions than is snag presence. In an ecological sense, "late-seral" is an inclusive but broader concept than "climax." For further discussion, see Dagley and O'Hara 2003 and Giusti 2007.

Managing stands to accelerate the development of late-seral conditions can be suitable for a variety of goals including increasing the proportion of old forests, wildlife habitat, ecological diversity, aesthetic enjoyment, recreation, and park management. Development towards late-seral conditions does not necessarily preclude production of forest products. However, accelerating and retaining late-seral conditions may not be the primary goal of timber production for some industrial or small, non-industrial owners of redwood land.

This effort to manage Brandon Gulch for accelerating the development of late seral forest conditions is an initial attempt for stands of this type. We expect that more information on such approaches will be developed over time as experience and experimentation increases. Experience and information developed on Brandon Gulch and on Camp 3 will help this learning process.

3. Brandon Gulch

Brandon Gulch timber harvest area is a 100-year-old, 528-acre, second-growth stand having a high percentage of redwood trees and substantial variability in species mix and density across the stand. It is located within the south fork of the Noyo River watershed (Figures 2 and 3, Appendix 3). An important feature is the presence of Class I and Class II streams. There are popular recreation trails and two rustic backcountry campgrounds.

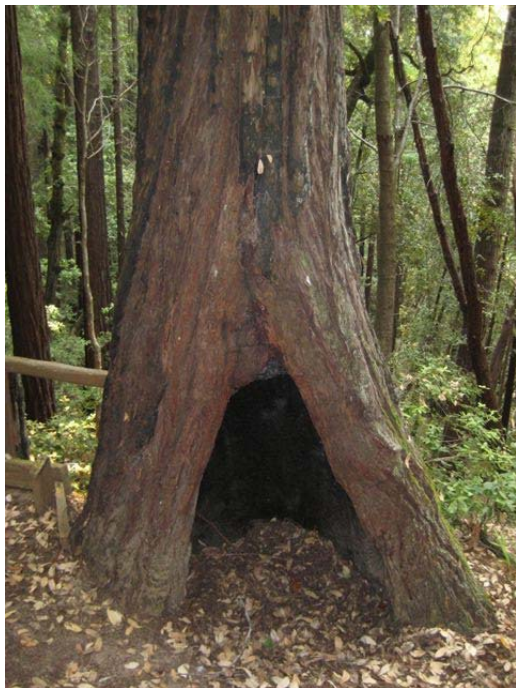
Productivity is Site Quality II and III with a high percentage of redwood trees but a substantial variability in species mix and density across the stand. The forest has grown up from natural regeneration following logging and burning in the late 1800s and early 1900s. Some small grassy openings were planted with Douglas-fir in the 1960s. The forest is basically even-aged with some remnant older trees; however stand conditions and tree sizes vary considerably depending on differences in soils, slope, and aspect. Generally, dominant and codominant trees have good growth, stem form and vigor with few bole cavities, broken tops, or epicormic branches. Tree density remains high due to active fire suppression. The current high proportion of tanoak in parts of the stand probably results from the early logging and subsequent burning. The stand averages 129 trees per acre greater than 12 inches diameter at breast height (dbh) with an average



Snags -- Used by cavity-nesting birds. If hollow, used by bats and refuge for other small mammals



Large Limbs -- Used as platforms for moss, lichens, epiphytes, and potential nesting for marbled murrelets



Goosepen -- Depending on size, used by bats and refuge for other small mammals

Figure 1a: Examples of structural elements in young redwood stands at JDSF that should be retained and increased to provide desired components of late-seral stands at Brandon Gulch.



Root Ball -- Provides coarse woody debris and small mammal habitat



Down Log -- Returns nutrients and aids soil formation. Provides habitat for small mammals, ferns, and fungi



Douglas-fir -- Retained for canopy diversity and recruitment of snags and down logs

Figure 1b: Examples of structural elements in young redwood stands at JDSF that should be retained and increased to provide desired components of late-seral stands at Brandon Gulch.

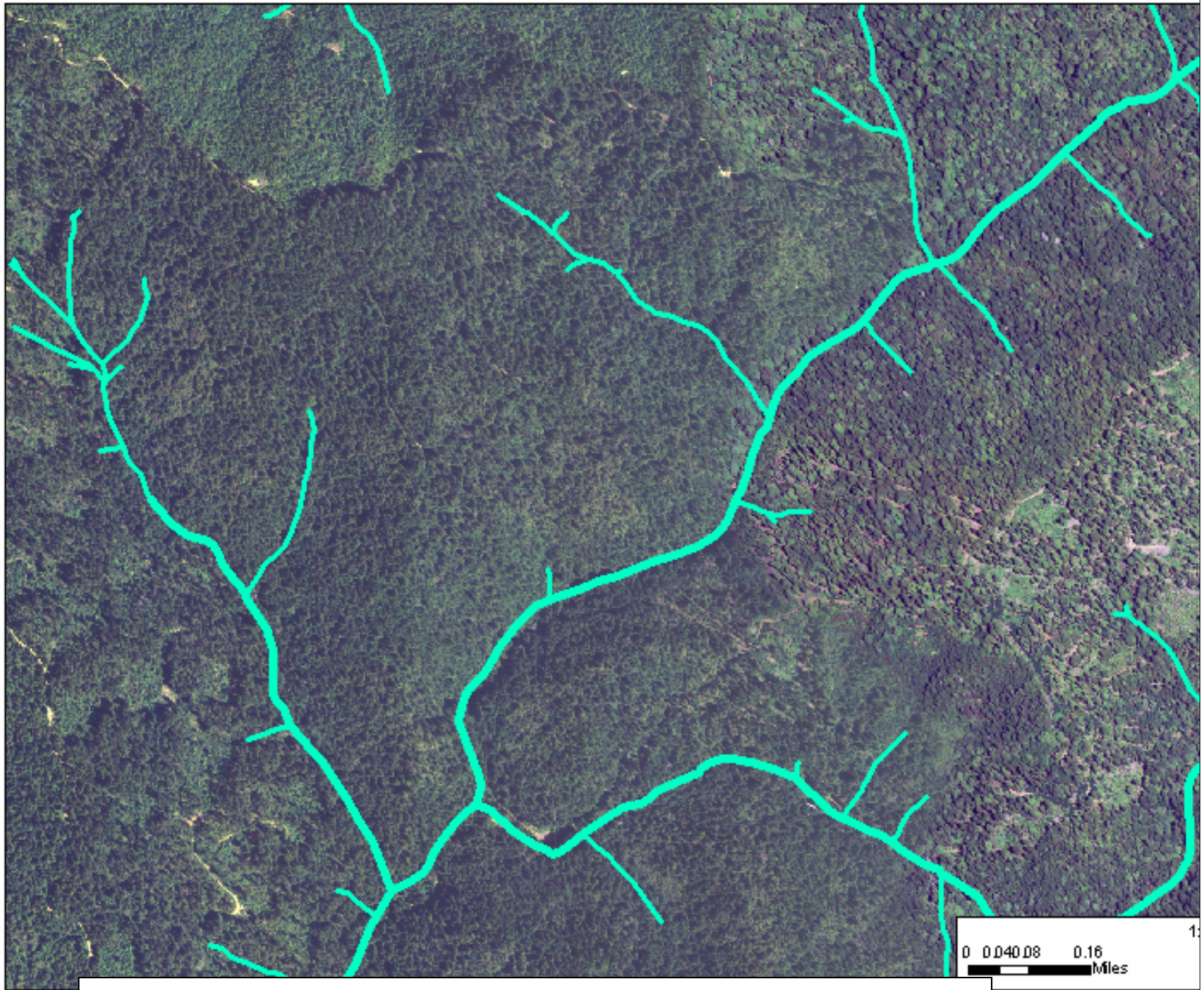


Figure 2: Aerial photo of Brandon Gulch showing hydrologic system and stand diversity.

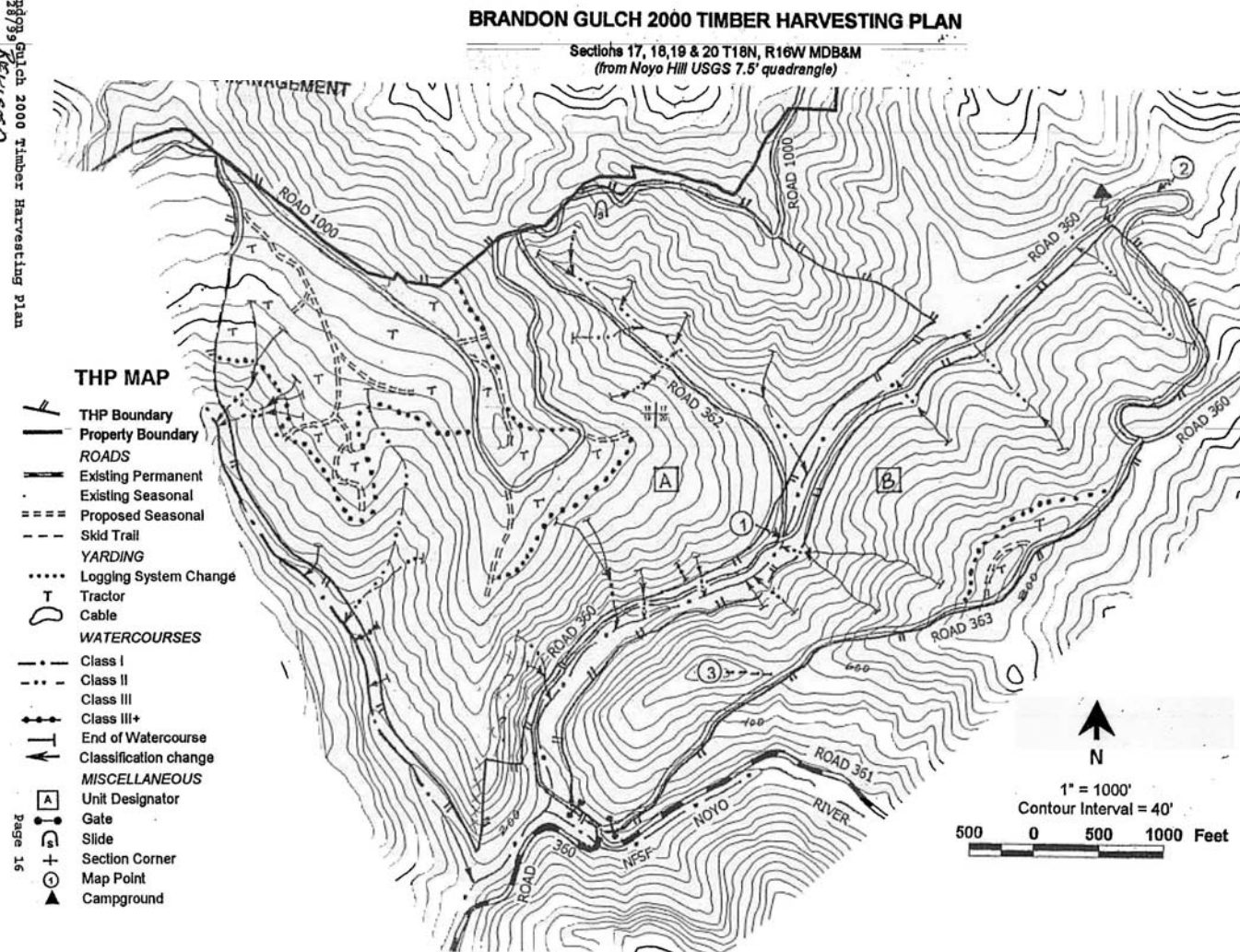


Figure 3: Topographic map of Brandon Gulch showing physical features

basal area of 373 square feet. Species composition is 70 percent redwood, 20 percent Douglas-fir, 5 percent grand fir and hemlock, and 5 percent hardwoods. The number of trees by species and diameter class is shown in Figure 4 and Appendix 4.

There is a high degree of variability in structural attributes of late-seral forests. However, existing information indicates that Brandon Gulch has a larger number of small trees relative to what might generally be found in late-seral forests in the THP area. There are approximately three snags per acre greater than 20 inches in diameter and these are primarily young growth Douglas-fir. Down logs are infrequent. Old growth stumps commonly have burned-out basal hollows or cavities

The area has evidence of use by Native Americans as well as historic logging and railroad sites.

4. Background Information

Purpose

This section is intended to provide a brief overview of some of the background information used by the JAG and its Late Seral Forest Development Committee to inform their development of a prescription intended to hasten the development of late-seral forest characteristics on the Brandon Gulch THP area. The available information regarding the treatment of 100-year-old second-growth redwood and Douglas-fir stands for this goal was limited.

Issues Considered

Forest management most directly influences forests through the practice of silviculture, which can be defined as “the theory and practice of controlling forest establishment, composition, structure, and growth,” (Smith et al. 1997, p. 3). The application of silvicultural treatments affects the species composition of stands, the range and distribution of tree age and size classes present, presence or absence of snags and down wood, and to some extent tree form. Section 2, above, discusses the characteristics of these and related factors found in late seral forests.

Since these are the key characteristics of late-seral forests that are most directly responsive to management actions, the research on and practice of acceleration of late seral forest conditions has focused on these characteristics and how they might be influenced through management. This fact has driven the research that is briefly reviewed below and the approach to management of the Brandon Gulch THP that is recommended here.

Information Used and Its Utility

A survey of literature on late-seral conditions and old-growth stands in redwood forests showed that most information relates to highly productive forests in state parks and industrially-owned forests in the northern parts of the redwood range and alluvial flats (Dagley and O’Hara, 2003; Lindquist 2004; Giusti 2004, 2007). Of special interest is the 1929 report on “virgin forest” from the original Caspar Lumber Company ownership of what is now JDSF shows stands having an average of 51 trees per acre – 24 trees in the 10-30 inch diameter class and 27 trees greater than 30 inches in diameter (Mason and Stevens, 1929). This report provides some idea of size-class distribution on the original forests of JDSF.

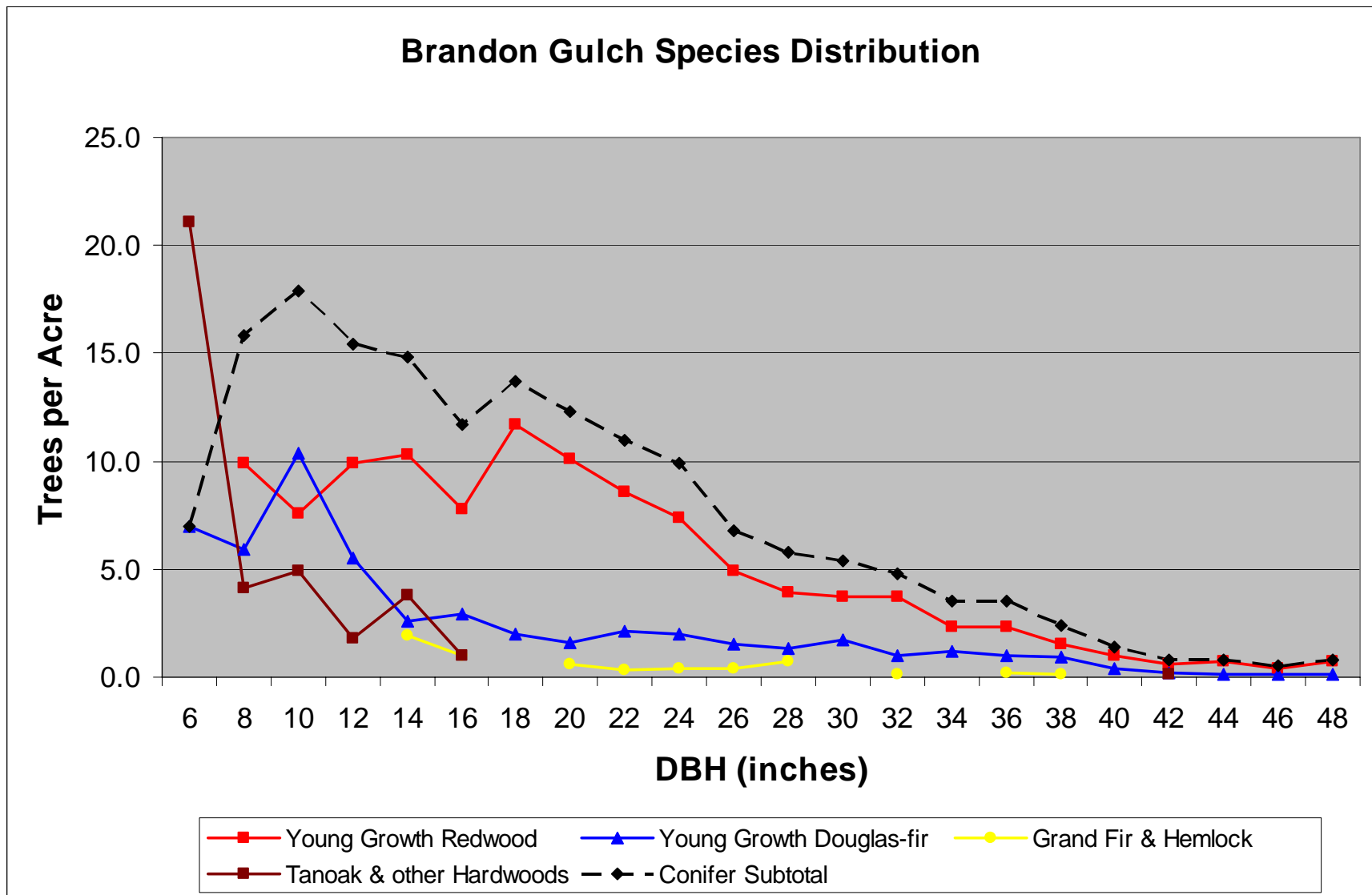


Figure 4: Frequency distribution of trees at Brandon Gulch by diameter class.

Previous experience in thinning redwood stands using a similar goal of accelerating late-seral conditions was available in a forest near Rio Dell, Humboldt County, managed by J. Able Consulting. This now 60-year-old forest has been thinned three times in 1988, 1999, and 2008. The most recent entry (June 2008) removed 30 percent of the basal area leaving the best and largest trees. Appendix 6 shows photographs taken in July 2008 of two stands in this forest which, because of having higher site quality and higher growth rates than at JDSF, enabled using a 10-year interval between thinnings.

Use of Models to Test Prescription Sensitivity

To provide guidance on the sensitivity of redwood stands to alternative prescriptions, five preliminary runs projecting growth and yield were made using the CRYPTOS growth model using a 60-year growth period. The model showed, in the long term, relatively little sensitivity to different prescriptions of light, medium, and heavy thinnings in terms of likely development of tree size, basal area, volume, and yields (see Appendix 9). However, it should be noted that the CRYPTOS model is not well suited for this type of analysis.

To provide further insight, the MASAM model that projects leaf area development was run using the same CRYPTOS prescriptions (see Appendix 10). Although this model was developed using data from redwood stands that are more productive than those at JDSF, it supports the view that the prescriptions being considered are likely to result in rapid crown closure. Moderate harvests of trees mainly in lower canopy classes will ensure that light levels will be sufficiently low to slow down the growth of sprouting redwood clumps. This is desirable to meet the goal of enhancing the development of old forest conditions. The importance of focusing prescriptions on canopy conditions is supported by Lindquist, 2004, who reported that "the growth of redwood regeneration is inversely proportional to overstory canopy".

Gaps in Knowledge

A few of the key gaps in our knowledge about how to accelerate the development of late-seral forest characteristics in second-growth forests are identified here. In general, little information is available on the manipulation of young-growth stands for the purpose of accelerating late-seral forest characteristics and conditions. Information that would be most useful for guiding prescription development for Brandon Gulch would be long-term (e.g., covering a treatment-response span of multiple decades) and would be from forests of similar age, species composition, and site quality as found in the Brandon Gulch area.

Although models can provide useful information on many aspects of stem distribution and stand development, these models typically have been developed to make projections related to productivity for commercial timber production. They tend to focus on commercial timber "rotation" lengths of less than 100 years and provide only limited information on many of the most important late-seral conditions and associated structural elements.

While we have substantial knowledge of tree growth and mortality in response to a wide range of silvicultural treatments, we have little information on the processes and timing for the initiation and formation of a number of the structural features of late-seral forests, such as for epicormic branches or the large, moss-covered "platform" branches that can serve as nest sites

for marble murrelets. Information on the establishment and development of the epiphytes that are characteristic of late seral forests also is lacking.

5. Approach to the Prescription: Enhance Old-Growth Characteristics

Although we do not know how forests evolve to old growth, we can observe characteristics of old forests. To the extent that we can encourage development of these characteristics without doing harm, we will be aiding late-seral development.

- **Big Trees** The most obvious characteristic of old-growth redwood forests is the population of very large diameter, very tall trees.

The population of bigger trees in Brandon Gulch can be enhanced by creating open space around the crowns of the existing larger trees. This will enhance their growth rate. Given the uncertainty about growth rates and long-term survivability, it seems prudent to aim for a moderate increase in growth and to retain some areas of greater competition.

- **Diversity and Complexity** Late seral, natural forests have a lot of variability, due to the wide variability in soils, degrees and directions of slopes, disturbance factors and the duration over which they accumulate, and effects of weather and terrain.

Brandon Gulch at 100-years of age already possesses substantial variability and complexity. The harvest in Brandon Gulch should enhance the diversity and the complexity. One way the complexity can be increased is to vary the fraction of trees thinned within sprout clumps.

- **Complex Crown Structures** Less obvious but equally important is the complex crown structure of old trees. The vicissitudes of long life lead to broken tops and growth of big, multi-divided branches. A whole ecosystem lives among these tops. Damage done in logging has been observed to cause trees to mimic some of the apparent growth-responses of old-growth trees to mechanical damage.

In Brandon Gulch, trees that have early signs of old-growth crown complexity can be retained. Additional top “damage” may be possible during the logging operations.

- **Complete Overstory Canopy** In an old-growth forest, the high-level canopy is generally continuous, but with gaps formed by tree fall, land slides, etc. This canopy provides the shady environment that causes understory trees to grow sparsely and slowly and that supports the typical old-growth biology.

The canopy in Brandon Gulch, which is now generally closed, will be opened by clearing spaces around the trees selected for enhanced growth. The amount and size of the openings should be such that the openings will grow closed quickly enough to prevent substantial growth of a new generation of tree sprouts from this entry.

- **Lots of Large Woody Debris** Old-growth forests have a large accumulation of fallen trees of widely varying ages. Most are old-growth redwood trees and thus survive on the floor for a very long time. These trees in various stages of decay provide habitat for animals and microbes. They constitute an important part of the ecology of late seral stands.

In Brandon Gulch, large wood debris is scarce compared to that in old growth forests. Much of what does exist is remnant from prior harvesting or from fir trees, which have less longevity than redwood. Non-dominant redwood trees that will eventually die and fall should be retained as potential recruitment for long-lasting large woody debris.

6. Recommended Prescription

As outlined in the Settlement Agreement, the Brandon Gulch prescription goal is to accelerate the development of late-seral forest conditions (Appendix 2).

Prescription Emphasis

The JAG-recommended-prescription differs from standard prescriptions for timber production. It emphasizes:

1. developing complex, multi-layered forest structure
2. minimizing regeneration so that it is similar to natural levels in late-seral stands
3. diverse horizontal stand variability
4. provisions for enhancing ecological diversity
5. increasing the proportion of larger diameter trees
6. increasing stand and crown complexity
7. retaining trees of various vigor conditions to maintain an on-going process of dead-wood elements recruitment.

Recommended Entries

A prescription of two entries approximately 20 years apart is proposed. Specifics of the second entry would be outlined following an evaluation of the first entry and subsequent 20-years growth (adaptive management). Selecting only one entry would involve a heavier cut and entail the risk of stand-level blowdown or a higher than desired amount of regeneration. Selecting more than two entries, although permitting adjusting stand density in smaller increments, would entail more harvesting operations and greater potential for accumulated disruption to ecological development.

Thinning Prescription

Prescription Emphasis A primary intent of the prescription is to provide selected large trees with increased growing space, yielding accelerated growth. Prescription emphasis will focus on: 1) accelerating the growth of dominant and co-dominant trees into larger size classes, and 2) retaining and developing other basic elements of late-seral conditions such as deformity, decadence, and abundant dead wood.

Existing groupings or clumps of redwood will be the source of most harvested trees and most will be thinned to variable levels to promote random stem distribution and variable growth responses. Entire clumps should not be removed to minimize establishment of a new cohort of regeneration. About 10 percent of the clumps should remain unthinned to

promote slow tree growth, fine tree rings, and enhance heterogeneity in stand structure. About 10 percent of the clumps should be heavily thinned to create patchy diversity.

Prescribing desired harvest goals in terms of stand basal area provides an overall guide to accelerating development of late-seral conditions. This does not, however, recognize existing variability in stand density and diversity or how to apply the prescription to maintain or enhance irregular, old forest structure. The task of professional staff will be to determine an effective and practical thinning approach, possibly with input from JAG in the initial phase of field implementation. One approach that could be considered is to develop rules using a list of thinning options together with a random number generator (designed to remove a stand average of 30 percent of basal area) to select the specific proportion of trees to be removed from a particular redwood clump. A similar approach could be developed to establish thinning guides for individual Douglas-fir trees and individual redwood trees between clumps. The rules would be constrained to leaving larger diameter trees, Douglas-fir retained for diversity and future snag production, and other desired ecological and diversity outcomes described below.

Stand Structure Old forests are characteristically very diverse and have heterogeneous structure both vertically through various canopy layers and horizontally across the landscape.

a) Vertical Structure and Canopy Diversity

Vertical structure can be promoted by developing multiple tree layers. These provide varied light and microclimates favorable to diverse populations of understory plants, animals, fungi, and lichens characteristic of late-seral redwood forests. Based on professional judgment and data available from other areas, species composition within a mature redwood forest at JDSF would probably range from 65-90 percent redwood, 5-20 percent other conifers, and 0-15 percent hardwoods, depending on site quality. These proportions should be used to guide treatments that affect overall vertical structure and canopy diversity.

b) Horizontal structure and spatial distribution

Encourage variable density and species composition across the landscape..

Old Growth The existing JDSF old-growth retention policy will be implemented (Page 104 JDSF Management Plan). This specifies retention of (i) large old-growth trees and (ii) old growth trees of any size that exhibit unique structural characteristics as described in the policy.

Tree Retention In general, all dominant trees will be retained except where their removal will enhance desired stand structure. Emphasis should be placed on developing stand variability, minimizing impacts on ecosystem components and functioning, and sensitivity to aesthetics.

Suppressed and Small Low-Canopy Trees These trees will mostly be left unthinned to provide shade and site occupancy and to repress new regeneration. Their numbers, however, will be reduced through light harvest and related logging activity.

Regeneration No targets should be made to manage regeneration and its occurrence will be incidental to stand treatments. The moderate thinning prescribed should limit light levels sufficiently to reduce the development and competitiveness of regeneration and redwood sprouts, which is needed to promote the development of late-seral conditions in this stand.

Tanoak and Other Hardwoods Hardwoods will generally be retained for wildlife and other values. This may depart from the JDSF Management Plan guideline (page 107) of retaining hardwood tree composition at approximately 10 percent (West end of Forest) to 15 percent (East end of Forest) of stand basal area. Hardwood composition and quality should be evaluated prior to the second entry and treatments considered to balance or enhance their role in the late-seral forest.

Sanitation/Salvage Cutting Limited cutting to salvage mortality or to mitigate the effects of insect or disease infestation or wildfire could be undertaken if these natural disturbances are so extensive as to detract from the goal of achieving late-seral conditions. Care should be taken, however, not to diminish meeting wildlife habitat and ecological goals.

Entries

Entry 1 Time 0 yrs. Remove approximately 30 percent of the existing basal area, primarily from intermediate and codominant crown classes. As shown in Figure 4, the current diameter distribution of trees at Brandon Gulch has a larger number of trees in the 16 inch and 24-28 inch diameter classes where a large proportion of the harvest should be removed. Figure 5 also shows the approximate projected distribution of diameter classes immediately after the first harvest entry and the likely distribution after growing 20 years. The effect of the first thinning treatment is to lower tree numbers and increase tree sizes (the curves are shown to move down and towards the right). Figure 5 also shows the frequencies of trees by diameter classes that were present in the "virgin forest" in the Caspar Lumber Company ownership in 1929 (Mason and Stevens, 1929) that can be used as an example of old growth condition.

Entry 2 Time 0+20 yrs. Following principles of adaptive management, stand conditions and responses after 20 years following the first entry should be evaluated relative to the goal of advancing late-seral conditions. This evaluation will require quantitative measures of stand growth over time. New research, demonstration, and experience will be available that will enable a more accurate assessment of the need for, timing, and nature of a second entry.

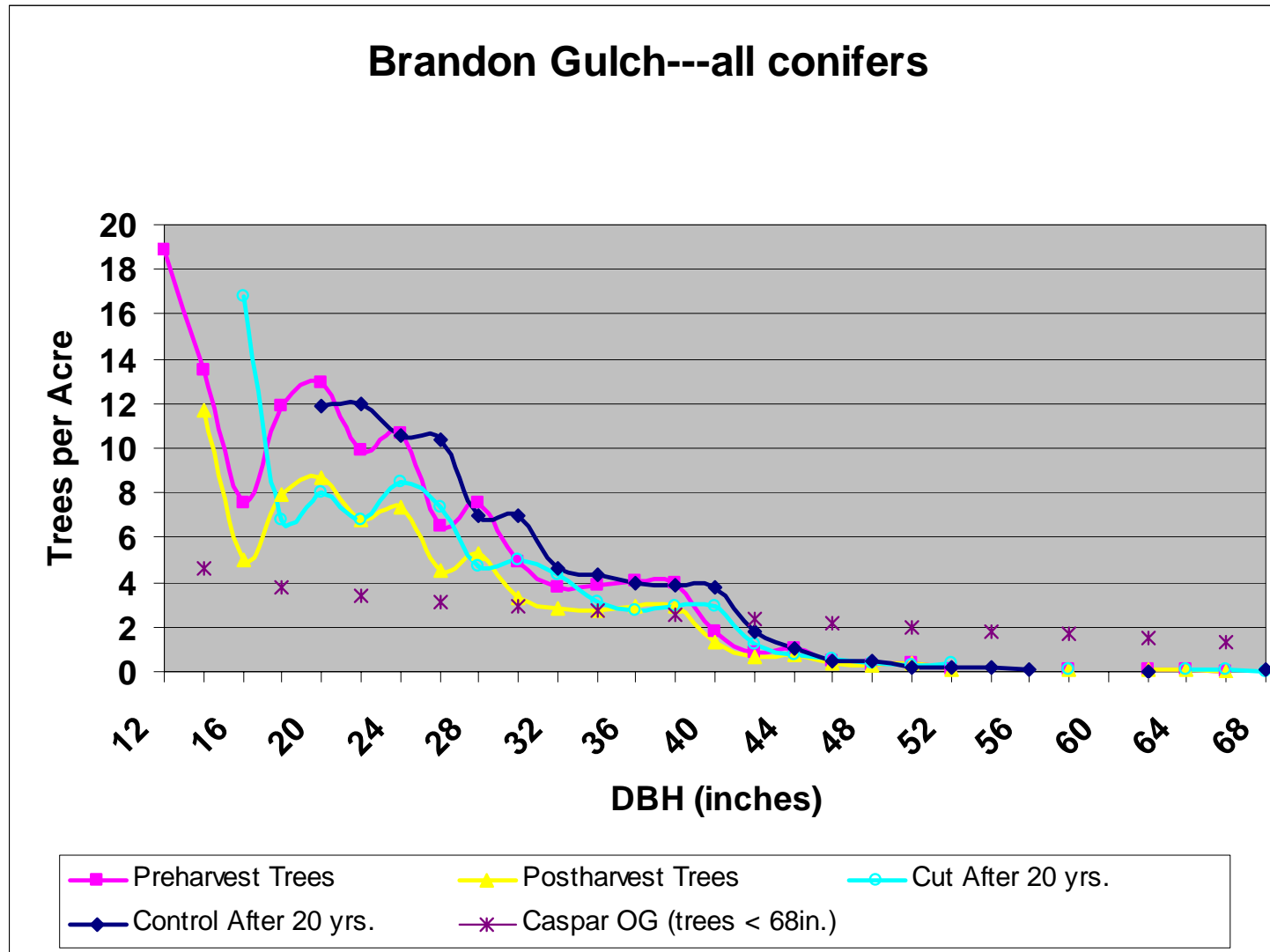


Figure 5: Frequency distribution by 2-inch diameter classes of all conifer trees in Brandon Gulch pre-harvest, post-harvest, and after projected growth of 20 years. No ingrowth of smaller size classes is shown. Superimposed is the number of trees by 4-inch diameter classes in a "virgin forest" in the Caspar Lumber Company ownership reported by Mason and Stevens, 1929. The graph of Caspar trees is truncated at 68 inches diameter with the database showing a maximum tree diameter of 126 inches.

7. Special Considerations

Recreation and Aesthetics

Recreation use on Brandon Gulch consists primarily of two campgrounds and use of recreational trails (Roads 360, 362, and 1000, see Figure 3) used by campers, hikers, bikers, equestrians, shooters, and unauthorized use of OHVs.

The direction given in the Settlement Agreement (Appendix 2) is to ensure that:

Recreation use will be considered when devising the THP amendments. Potential harvest modifications to reduce visual impact on recreation users, including but not limited to those provided by the Management Plan and the Forest Practice Rules, shall be considered for incorporation in the THP amendments.

To meet this directive, treatments should be applied in the close vicinity of campgrounds and trails to mitigate the effects of timber harvest and to enhance vegetation development that promotes desirable aesthetic and visual conditions. Concerns and suggestions provided by recreation-user comments (Appendix 7) should be considered in carrying out timber harvesting and mitigating its effects. JDSF staff will work with timber operator to reduce the visual impacts of the timber harvest.

The following elements provide additions or emphasis to the recreation guidelines in the Management Plan:

- 1) Roads and Trails: Roads 360, 362, and 1000, are used by hikers, equestrians, and trail bike riders and are valued for providing aesthetic experiences and views of the forest. JAG members agreed on the objective of maintaining high visual quality for trails and campgrounds. JAG considered but rejected no-harvest setbacks as a means to accomplish this objective, feeling that the adopted approach would not produce significant adverse effects, setbacks would unnecessarily constrain harvesting opportunities and operational flexibility during harvesting. In addition, JAG found that ruling out harvesting next to trails would, over the long run, prevent trail users from being able to see into the more visually rewarding late-seral forest. Thus, JAG recommends allowing a lighter-than-average prescription within buffer zones along roads and trails, with the prescription and operations implemented with the goal to recover visual quality in 3-5 years after harvest. The buffers zones would be 100 feet or sight-distance from the edges of the above roads or trails, whichever is less. All logging slash within the buffer shall be uniformly lopped to within 30 inches of the ground.

Trails along streamsides are especially scenic and buffers along Brandon Gulch and the North Fork of the South Fork of the Noyo River may exceed specifications of the Forest Practice Rules to protect particular identified values. Sherwood Trail is of particular importance requiring special maintenance to prevent erosion. Trails used by equestrians should provide adequate width and overhead height clearance.

After harvest, all trails should be restored as much as possible to their original or desired condition. All trails and trailheads within Brandon Gulch should be well marked and mapped. Opportunities should be taken to provide information to the public on sustainable forest management, advancing late-seral stand conditions, and balanced resource use on portions of trails from which harvesting can be observed.

- 2) Existing Campsites and Day-Use Areas at JDSF provide a remarkable sense of solitude and therefore careful attention is required to ensure adequacy of setbacks. Setback size should be 200 feet within which harvesting should be excluded (Management Plan, page 275) with added sensitivity given within 300 feet (Management Plan, page 119). Prior to harvesting, onsite evaluation of potential visible impacts should be conducted by JDSF staff and one or more JAG representatives to ensure that desirable visibility screens are prescribed. These will likely vary considerably around campsites due to variability in terrain and vegetation. Thinning near campgrounds and day-use areas should be limited to enhancing understory development, future screening, and removing potential hazard trees. Planning for thinning should be controlled by visual confirmation from professional staff in the campground, possibly with input from JAG in the initial phase of field implementation. Riparian buffers may exceed standards of the California Forest Practice Rules to protect special values at particularly important locations of recreation areas.
- 3) Cable Corridors should be kept as narrow as possible and, if practicable, aligned to minimize visibility. Care must be taken to avoid injuring leave trees at the edge of corridors.
- 4) Tractor Logging should leave as much vegetation as possible for visual screening from roads and trails. Tractor use should be restricted when soils are moist to avoid soil compaction.
- 5) Landings and Access Routes should be limited to the minimum size needed consistent with providing safe working areas. Landings (including those from previous logging entries) should be cleaned up and planted unless designated for reuse. All access roads and landings should be decommissioned by covering with slash to limit non-authorized use, stabilize surface soil, and enhance regeneration of native plants. Special care should be taken to avoid conditions conducive to establishment of exotic plants.
- 6) Logging Debris away from trails and visitor use will be treated using standards within the Forest Practice Rules. Slash abatement may in places exceed the normally-prescribed 50 feet from a road (Management Plan pages 119 and 273) to reduce fire risk or enhance recreation and aesthetic values.

Wildlife

Wildlife species likely to occur on JDSF are listed in the Management Plan (page 18). Over the course of time after the prescription has been applied, increased diversity of wildlife populations is likely to develop corresponding to enhanced diversity of vegetation and other flora, size of trees, and increasing amounts and conditions of late-seral elements such as snags, down logs, and cavities.

Wildlife expected to occur in stands of different type can be predicted using the California Wildlife Habitat Relations model. Although the model is not explicitly designed to address "late-seral" as a distinct type, it can be simulated. A "Species Comparison" model predicts that redwood stands with canopy cover greater than 40 percent of trees greater than 24-inches in diameter, and with a multi-layered canopy to be inhabited by 167 wildlife species. Of these, none were found exclusively in vigorous stands, 44 were found in both vigorous and those with late seral characteristics, and 123 species were predicted only in forests having elements typical of late-seral conditions, 123. A "Habitat Value" model predicts that 60 species were insensitive to the modeled stand conditions, 56 minimally sensitive, 19 species moderately sensitive, 9 species strongly sensitive, and 23 species predicted to have no habitat value in young stands. These predictions suggest that a broader array of species is expected to find suitable habitat in forests with adequate amounts of the decadent elements that typify late-seral forests (see Appendix 8).

Brandon Gulch and the North Fork of the South Fork of the Noyo River provide habitat for coho salmon and steelhead trout and both species are found during most years. Over most of the past 20 to 30 years, juvenile populations have been dominated by steelhead, but during some periods when ocean conditions and spawning coho populations are high, coho are dominant. Historically, coho spawning and juvenile populations were much larger than steelhead and this situation may return when streams are restored to previous conditions. Although large woody debris is critically important to both fish species, Coho, especially, favor deep pools and cover provided by down logs, slower water, and clean gravels. The current, low occurrence of logs is due to historic logging practices and mis-guided restoration efforts. An important component of accelerating late-seral stand conditions is to increase recruitment of large woody debris in the two streams and take other measures as prescribed in the Jackson Management Plan (pages 8, 23, 63, 104, and elsewhere).

Brandon Gulch has been surveyed for potential marbled murrelet nesting habitat with none identified, thus there is little likelihood of "take or impact" (Management Plan pages 18, 61, 66, and elsewhere). Surveys should continue to be conducted annually for northern spotted owl and habitat protected as outlined in the Management Plan, page 64.

1) Snags and Coarse Woody Debris

Snags. JDSF Management Plan guidelines (page 106) will be followed for the first entry, and preferably exceeded, requiring no less than three snags per acre -- two greater than 20-inches dbh and one greater than 30-inches dbh -- distributed unevenly across the landscape. Active creation of Douglas-fir snags in the first entry might not be feasible due to their current small size. The Management Plan guidelines are unlikely to adequately meet levels of snags and snag-topped trees normally found in stands approaching late-seral condition, and specific targets should be evaluated prior to a second entry.

Conifer and hardwood trees having current or potential value for wildlife, mast production, or as hosts for other biota such as epiphytes, fungi, and lichens should be retained considering both the short-term period between treatments and the long-term period beyond the second entry. Trees retained for potential wildlife values, snags, and coarse woody debris should vary in vigor. In particular, dominant Douglas-fir should be retained that exhibit low vigor and slow-growth (finer rings), are diseased, and have heavy limbs and

cavities. Exceptions are trees that must be removed for safety reasons, for example near trailheads.

Coarse Woody Debris. Management Plan guidelines are unlikely to adequately meet levels of coarse woody debris loading normally found in stands approaching late-seral condition. During the first entry, JDSF Management Plan guidelines (page 107) will be followed, and preferably exceeded, requiring no less than three down logs per acre 20 feet long -- two greater than 16 inches dbh and one 24 inch dbh at the large end -- distributed unevenly across the landscape. If the stand is found to be deficient in this material prior to the second entry, methods for increasing the supply will be considered. Existing down logs and larger, dead trees should, as far as possible, be left undisturbed to maintain wildlife values. Coarse woody debris from hardwood trees should be encouraged to provide needed habitat diversity for animals and plants.

The presence and quality of snags and coarse woody debris should be assessed against desired targets prior to considering the second entry. Specific targets and treatments can be developed at that time in light of changed conditions.

- 2) Species Protection and Habitat Management: Prior to the first and proposed second treatment entries, Brandon Gulch should be surveyed for species protection using standard protocols and guidelines endorsed by the appropriate federal or state agency (JDSF Management Plan, beginning page 110).

Forest Ecosystems

Biological diversity (fauna and flora) should be evaluated prior to the first and second entries to determine what management activities are needed to ensure long-term conservation of existing or needed species common to late-seral forests in the Brandon Gulch area (see JDSF Management Plan, page 107). Attention should be addressed not only to the presence of these species, but ensuring conditions for diverse and healthy ecosystem processes and functions by providing habitat (retaining old forest elements) and encouraging the use of prescribed fire. Attention should be given to enhancing diverse populations of understory plants, animals, fungi, and lichens. As stated in the Management Plan (page 108), survey protocols should be established after consultation with state and/or federal agencies, recognizing that the Brandon Gulch area is not designated primarily for research purposes and has high recreation and education values.

- 1) Understory: Shrubs and groundcover should be impacted as little as possible. Some level of disturbance will occur from logging operations but those impacts should be limited and restricted to skid trails, landings, roads and other necessary infrastructure needed for harvesting.
- 2) Legacy Trees, Snags, and Down Logs: Avoid locating skid trails, treatments, and causing logging damage in areas where adverse impacts would occur to existing ecosystem components and structures needed to provide critical elements of ecosystem and late-seral structures. The largest trees commonly left from early logging, snags, and down logs constitute important ecological "legacies" and should be protected.

- 3) Elevated Structure Development: Late-seral redwood forests are characterized by elevated deformities in trees that typically result from mechanical damages that accumulate over time due to wind, wildlife damage, adjacent tree fall, etc. Important tree characteristics include reiterated trunks (redwood stems in which large, upturned branches form complex, multiple-crown structures), large branches with varied growth patterns, snag tops, and broken tops. To ensure that harvesting does not inadvertently set back the amount and development of these elevated structures, retention of existing trees with these features should be a high priority.

Prescribed Burning

Prior to early logging, the return interval for low-intensity forest fires in the Mendocino redwood forests was 5-25 years. From an ecological standpoint it would therefore be desirable to reintroduce fire into the redwood ecosystem.

It is recommended that, after the first prescription entry which will be done mechanically, stands be evaluated to determine whether progress towards desired stand structure could be advanced and demonstrated by prescribed burning on suitable portions of the Brandon Gulch. Burning should be prescribed to mimic natural, low-intensity ground fires and would mostly affect Douglas-fir, lower potential fuels, reduce stand density in the lowest size classes, promote plant diversity, create char on large, down woody material and trees, and encourage basal cavities or goosepens in redwood. The timing of burning should mimic the late summer/early fall fires typical of the natural fire regime, but obviously would be governed by weather and atmospheric conditions, fuel moisture levels, and operational and legal constraints.

Exotic Invasive Plants

Special effort should be made to control exotic invasive plants that are evident on JDSF, especially along roads, using guidelines established in the JDSF Management Plan (pages 10, 28, 38, 51, 93).

8. Demonstration, Interpretation, and Education

Brandon Gulch is intended as a demonstration area and particular attention needs to be given to defining what is meant by demonstration, interpretation, and education. It is especially important to determine the amount and kind of quantitative information needed to demonstrate and explain the nature and purpose of the prescription, associated costs, the extent to which it is actually accelerating the development of late-seral conditions, and effectiveness of treatments aimed at maintaining and enhancing recreation use.

Suggestions for possible demonstration, interpretation, and education include:

- Maintain costs and other details of administration and operation for use by other landowners. This analysis should identify both “normal” operational costs and additional costs that result from the special demonstration emphasis on late seral forest development. Additionally, forgone revenues should be estimated.
- Identify key challenges and opportunities to managing for late-seral development.

- Evaluate the applied silvicultural prescription for advancing late-seral (or old forest) development.
- Identify and explain treatment effects on ecosystem components such as understory and tanoak.
- Use interpretative signs and self-guiding trails to inform the public regarding stand growth and use of silviculture to enhance late-seral conditions.
- The old railroad grade up the North Fork of the South Fork Noyo River provides an excellent opportunity to provide public information on logging history and forest recovery from past logging operations that were commonly carried out both in and alongside streams.
- Encourage opportunities for diverse, collaborative initiatives for demonstration (and research). For example: 1) treatment(s) such as branch and/or canopy manipulation aimed at enhancing late-seral development; 2) evaluate changes in northern spotted owl prey base as late-seral stand conditions are advanced.
- Create snag-top or snag Douglas-fir and redwood for wildlife habitat.
- Develop questionnaires to solicit hiker, camper and equestrian input and conduct periodic surveys over 5 years to measure public reactions to the effects of the Brandon Gulch timber harvest plan on visual qualities along roads, trails, and campgrounds.
- Establish photopoints to enable sequential photos over time to show “before” and “after” treatment effects on stand development and views into the forest from trails and roads.
- Demonstrate compatibility of managing forests for wood products while accelerating late-seral conditions.
- Evaluate at approximately year 5 whether there are feasible opportunities to enhance late-seral-associated habitat features, floral and fauna, without engaging in commercial harvesting activities.

9. Literature Cited

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10. Appendices

1. Members of the Jackson Demonstration State Forest Advisory Group and the Late Seral Forest Development Committee
2. Prescription Goals from Settlement Agreement.
3. Brandon Gulch Forest Stand and Resource Description
4. Brandon Gulch Unit Forest Resource Inventory Report.
5. Old Redwood Forest Stand Characteristics
6. Two Redwood Stands at Rio Dell after Three Thinnings
7. Report of Meeting of the Recreation Committee of the Jackson Advisory Group. June 28, 2008.
8. California Wildlife Habitat Relations Assessment of Consequences of Late-Seral Management on JDSF
9. Projections of Preliminary Prescriptions for Brandon Gulch Using the CRYPTOS Simulation Model.
10. Projections of Leaf Area Index for Brandon Gulch Preliminary Prescriptions Using the MASAM Simulation Model.